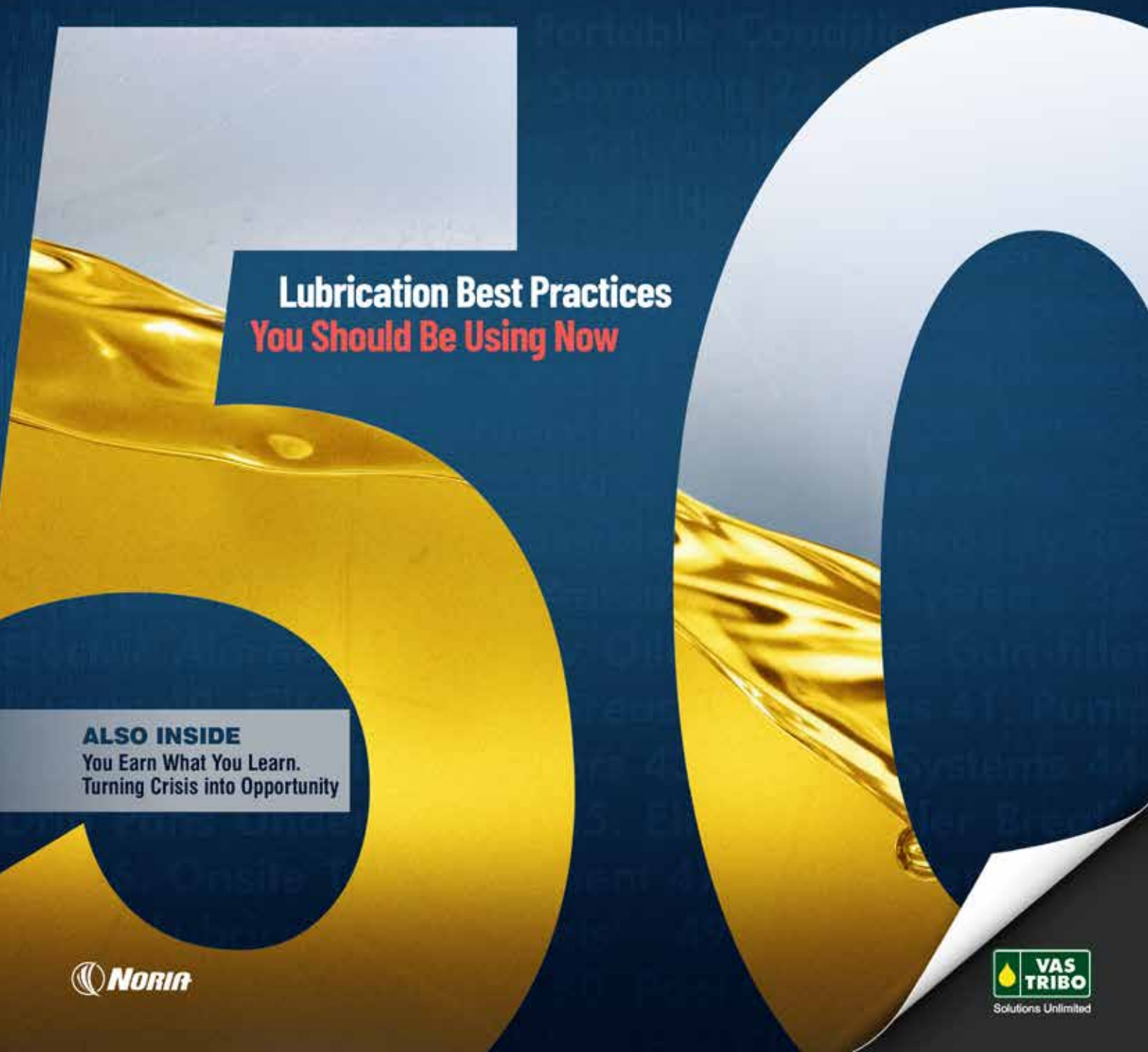
November-December 2020

Machinery Lubrication

INDIA

machinerylubricationindia.com



Lubrication Best Practices You Should Be Using Now

ALSO INSIDE

You Earn What You Learn.

Turning Crisis into Opportunity

LIVE

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2021 Online Training Calendar

Essentials of Machinery Lubrication (MLA I / MLT I)			
18-21st January	22-25th March	26-29th July	22-25th November
Oil Analysis Fundamentals (MLA II)			
22-25th February	26-29th April	23-26th August	13-16th December

With International Council For Machinery Lubrication (ICML) Certification

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MLI November-December 2020

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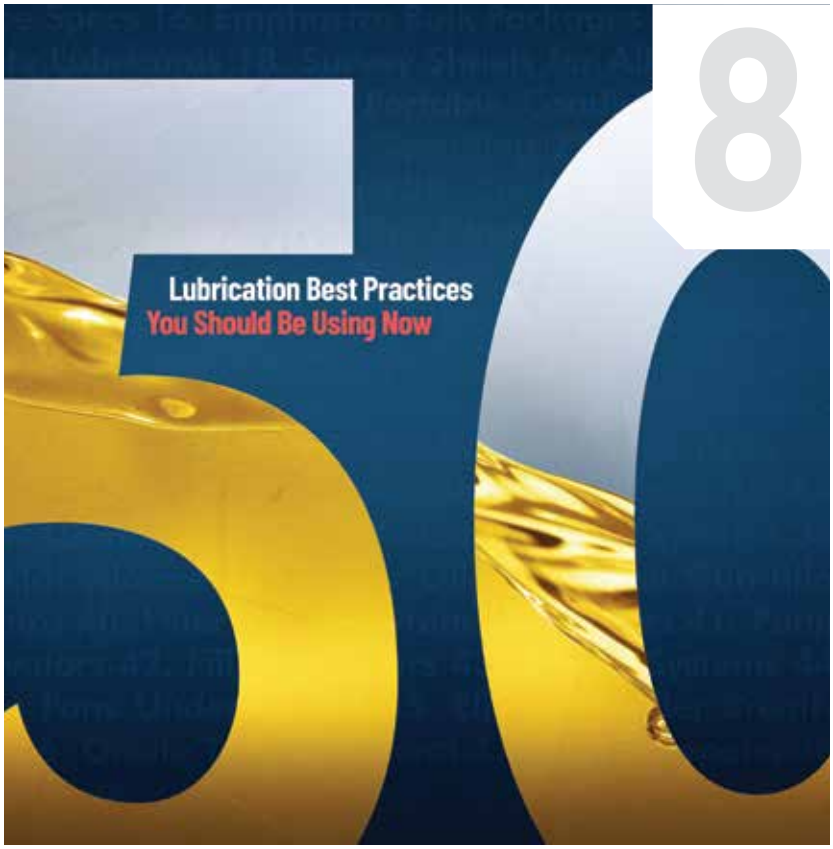


AS I SEE IT

EDITORIAL FEATURES

Publisher's Note

Welcome to our 50th edition. Since our very first issue (Sep-Oct, 2012), this magazine has been devoted to providing value to lubrication. We always try to publish the most valuable articles and our brilliant authors deserve credit for sharing their ideas and experiences.

Keeping in mind the current scenario, we have increased our reach through digital mediums. Readers can also visit our website for easy reference of the past issues. We have introduced a section last year named 'Great pioneers that inspire us' in which we feature about the life, achievements, research, writings of great pioneers who made a profound impact on industry & academia. We have also introduced 'What if...?' in which we explain a particular situation and how the author handled or resolved the situation. These have proven to be popular and successful additions.

In our 50th issue, we are covering '50 Lubrication Best Practices You Should Be Using Now' along with many informative articles. We are planning to introduce a section called 'Buyer's guide' - a comprehensive directory of companies who offer products and services within the machinery lubrication, reliability maintenance, and oil analysis space. This will bring the buyers closer to the quality suppliers of related goods and services. Look out for this addition soon.

After our successful live interactive online trainings, we are also planning to host a series of webinar on various subjects of lubricants, lubrication and reliability. In this you will get an opportunity to hear and communicate with experienced lubrication professionals.

We thank our readers for sending their feedback and sharing their experiences reading our magazine, you can read it in 'From the readers' section. The reason why this magazine exists and why the articles are even being published is because of our readers. Keep reading and recommending our magazine 'Machinery Lubrication India' to your friends and colleagues. Having such a large audience, we are fully aware of our responsibilities and we'll make sure to stay true to our values and principles in future.

We would like to thank each and every subscriber, advertiser, author and our partner (Noria Corporation, USA) for constant support and encouragement.

A personal note to our advertisers- we thank you for advertising with us and more importantly, your confidence in us. We look forward to your contributions and insights.

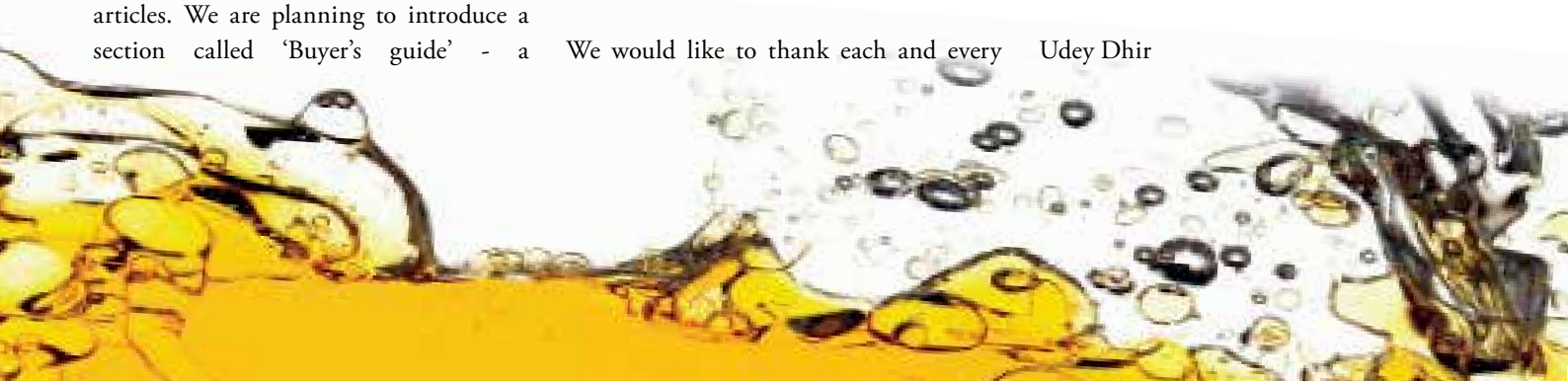
We would like to thank our readers for the heartening response to our previous edition's cover story – "Oil Analysis or Vibration Analysis? Which is better and when to use each technique" and other articles. As always, we look forward to your valuable suggestions and feedback.

Despite the gloom that engulfed the world with the onset of COVID-19, we see enthusiasm and resilience of the lubricants industry. To the new beginnings and extended potential, wishing you all a Merry Christmas & A Very Happy New Year.

Enjoy the read!!

Warm regards,

Udey Dhir



You Earn What You Learn
Turning Crisis into Opportunity

"Honestly, there could hardly be a better time to prepare and adapt for the future that lies ahead."

Live Online Training is just one of many training solutions Noria provides during this time of social distancing.

2020 will be known as the year when the world was forced to shelter to protect human lives and to stem the spread of a potent, invisible enemy … COVID-19. The dire economic consequences of this virus are affecting us too. Is it possible there is a silver lining?

Some have used this life-disrupting period to find and leverage key opportunities, both personal and professional. This includes planning and making ourselves, our careers and businesses ready for the time when we emerge at the other end of chaos.

Honestly, there could hardly be a better time to prepare and adapt for the future that lies ahead. View it as a time to reload and recalibrate. We are transitioning through both forced and necessary changes to a new normal. Things will never be quite the same. The opportunity is there to become

stronger and wiser. Of course, this includes the field of lubrication and reliability.

Training organizations worldwide are scrambling to advance educational options that align with this new normal. These include various forms of distance and e-learning that include virtual and mobile device deliverables. Lack of mobility from this pandemic does not have to mean a lack of productivity from lost time and wasted resources. It is our choice to be people of action and purpose. More now than before.

What follows are common questions and challenges related to the concept of training and its true value relative to actual and perceived costs. Is training a want or a need? Are the benefits real or imaginary? What is the tangible connection of training to machinery reliability, maintenance costs, productivity and profitability? Read on…

1. Question: What if We Train Our People and They Leave?

Answer: What if We Don't Train Our People and They Stay!

Noria is a training organization, among other things. Since our inception, we have heard people question the wisdom of training and certification. One common argument is the concern that a trained workforce would result in higher turnover (employees marketing their new skills). From my experience, this is more myth than reality.

People have an innate need to do good work. When people do bad work, they feel bad about themselves and their job. They look for other job opportunities. Conversely, when people do good work, they feel good about themselves and their job. Training enables good work, job satisfaction, and workforce retention.

Additionally, job skills, knowledge and good work propagate. People teach each other. This knowledge permeates and lasts long after the originally trained persons have moved on through attrition or retirement. This is especially true when advanced training concepts are used to update task procedures and tools. When training leads to sustained change with real value, then training should be viewed as an asset. After all, the definition of an asset is something that has future value.

On the other hand, without transformational training, old-school ideas and methods remain entrenched. Although their intentions are good, the teachings of many old-timers propagate the use of substandard methods and impair opportunities for change and improvement. Sadly, this induces and sustains a state of unreliable asset performance and high maintenance costs.

Training both impacts and attracts good quality employees. Imagine that your people leave, what will they say about their experience at your plant? Let's face it, social media is a megaphone. If people leave do you want the message to be "they didn't develop or care about their people," or "it was one of the best experiences of my career, if you can get a job there, do it!"

2. Training Drives Overall Workforce Effectiveness (OWE)

Most of us have heard of overall equipment effectiveness (OEE). This widely used metric is the arithmetic product of three factors: machine availability, machine performance, and product quality. It's a great "big picture" snapshot of a plant's general reliability program.

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Improving OEE requires improving one or more of the three factors. Looking at each of these three factors, from an operations and maintenance viewpoint, requires improvement in such things as work methods, skills, tools, culture, etc.

Workforce training seems to drive most anything that is desired, including OEE improvement. We do what we learn and understand; the what, the how, the why, the when, the where. The opposite is equally true. In fact, you may have heard of overall workforce effectiveness (OWE) (aka overall labor effectiveness).

Like OEE, the same three factors apply for OWE. Moving the needle on OEE means we must move the needle on OWE; they are in lock-step (Figure 1). Look at these OWE factors in the context of people skills, awareness, and standardized work:

Availability. A well-run maintenance program may also be known as precision maintenance and planned maintenance. This is the opposite of breakdown maintenance. Maintenance personnel are available because of planned work, not emergent work, and doing the right things right, the first time every time. Under a planned maintenance program with skilled workers, increasing workforce bandwidth does not need to require increasing your workforce headcount or even hours worked. Precision and efficiencies make time and free up resources.

Performance. Effective, up-to-date training can increase performance by improving the skills that directly impact the productivity of work performed. A skilled maintainer, technician, millwright, analyst, operator, etc. should know the correct procedure, the correct tools, etc. to perform a task quickly and efficiently. You've heard of the Optimum Reference State. Doing the optimum is enabled by knowing the optimum (through training and standardized work).

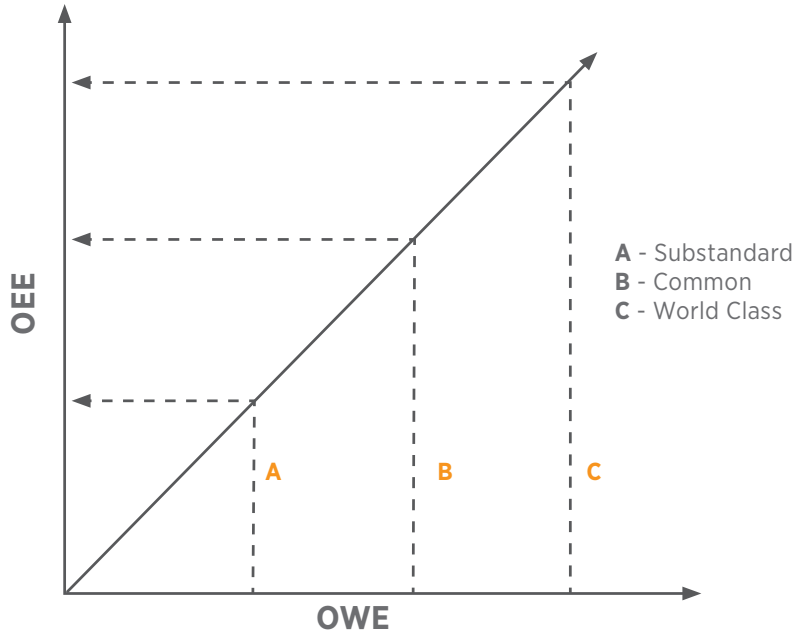

Figure 1. The lock-step relationship between overall workforce effectiveness (OWE) and overall equipment effectiveness (OEE).

Quality. While performance is productivity related, quality influences the sustainability and effectiveness of work performed. There are right and wrong ways that affect performance and right and wrong ways that affect quality. Precision lubrication relates to the precise selection of lubricants, the right amount, the right frequency, the right method, the right location, the right cleanliness, the right inspection method, and so much more.

There are so many choices that technicians and operators face in performing maintenance tasks. The same is true with reliability and lubrication engineers. We don't know these things by instinct. The life expectancy of lubricants and machinery components directly relates to the choices we make and the choices we don't make. For instance, let's connect this to oil analysis — who in your organization is going to answer these questions and, most importantly, get it right?

- Right machines to sample
- Right sampling frequency
- Right sampling location
- Right sampling procedure
- Right lab selection
- Right tests to perform
- Right alarms and limits
- Right data interpretation strategy

Training drives change in workforce availability, performance and quality. A penny saved — by not investing in training — is not a penny earned, but rather hundreds of dollars forfeited all for the quest of a penny.

3. The "Unlearning" Component of Real Education

Not so many years ago, people put particles of cork and wood pulp in automobile engines because they believed it improved

lubrication and reduced noise. This is just one example of many outlandish ideas that still endures in the lubrication world. You've probably heard a few yourself. You know what I mean, those ridiculous claims about lubricants and lubrication, that over time, evolved into urban legends.

Much of this folklore has surfaced from a single exaggerated or misinterpreted fact and spread from there. Many stories have been scientifically discredited but still linger in the lubrication community.

For instance, can you distinguish fact from fiction from the statements in this list?

- Although more expensive, engine oils make superior hydraulic fluids due to the more advanced additive packages and base oils.
- Most grease products readily absorb water in service, which is actually a design feature to improve lubrication.
- Sludge in the bottom of a sump is harmless unless disturbed.
- Lubricants are considered clean if you don't see particles or feel a gritty texture.
- Most all gear oils lose critical additives if filtered below 10 microns.
- Grease is better than oil at controlling friction and wear in rolling-element bearings. This is the reason far more bearings are lubricated with grease compared to oil.
- Oil analysis is generally a waste of time and resources for lubricants coming from small compartments (e.g., less than 4 liters).
- Particle counting by oil labs is unnecessary for diesel engine lubricants.
- The capture efficiency of oil filters always gets better over time in typical service.
- The best way to control water contamination in industrial equipment is to keep the oil hot.
- Different brands of quality turbine oils can be mixed safely, without loss of performance.

Figure 2. We all want greater value and lower costs from lubrication and reliability initiatives. Culture drives fundamental success elements and most importantly sustainability of the transformational investment.

Of the 11 statements, how many did you think were true? Perhaps five or eight? Each of these statements have been reported to be true by people who claimed they knew their facts. The reality is that none of these statements are true. Even worst, today, people still make maintenance decisions based on many false assumptions and outdated information. Training is an excellent means to clear up misconceptions of what's fact and what's fiction.

4. Training Fosters a Nurturing and Productive Maintenance Culture

Warren Buffett once said, "Confidence is like oxygen. When you have it, you don't think about it. However, when it's gone, you know it immediately, and you want it back." Culture is much the same way.

Culture is a critical plant asset. Some plants have it, and many plants do not. Culture decides who we hire and who we don't. Culture advocates continuous learning and exceptional job skills. Culture says yes to right tools, machine improvements and right procedures. The culture celebrates proactive successes and purges reactive maintenance habits. The list goes on.

A prosperous plant culture is a learning culture. Education, when effective, takes people out of their comfort zone. It not only builds intellectual capital but, over time, fosters a behavioral desire to do good, quality, sustainable work.

It also builds team loyalty and dedication to achieving business goals. People learn

differently, so don't assume knowledge is only acquired in a classroom. Certification instills pride and should be the capstone to each learning stage by providing visible recognition of skill competency.

Let's get trained! **ML**

About the Author

Jim Fitch has a wealth of "in the trenches" experience in lubrication, oil analysis, tribology and machinery failure investigations. Over the past two decades, he has presented hundreds of courses on these subjects. Jim has also published more than 200 technical articles, papers and publications. He serves as a U.S. delegate to the ISO tribology and oil analysis working group. Since 2002, he has been the director and a board member of the International Council for Machinery Lubrication. He is the CEO and a co-founder of Noria Corporation.

Contact *Jim at jfitch@noria.com.*

WHAT GREAT COMPANIES DO

By Chris Christenson Director of Education, Noria

As I have been 'sheltering in place,' I am reminded of what successful companies do in times like this; they invest! I believe Tim Collins discovered this concept when interviewing company leadership for his book, *Good to Great*. He identified that great organizations use downturns to invest in the process and their people and prepare for the future.

We have quickly developed our Live Online Training courses as an excellent solution to help you invest in your teams at this time.

Don't let current events prohibit investment in your team. For all the challenges that event-based training can pose for learners and organizations, live online training provides convenient flexible, and results-oriented options to solve unique situations. As we have developed the live online training, we considered these advantages:

- **Multisite access** – Train team members in multiple locations, even in their homes.
- **No travel costs** – Training comes to you.
- **Close to the plant** – Keep your team available; flexible options allow team members to connect with the daily activity of the plant while attending a live course. Training can be scheduled once a week, multiday training.
- **Public training online** – Monthly hosted events are available for smaller groups of students
- **Interactive improves engagement** – Each live online training, includes demonstrations, interactive polling, chat and question-and-answer sessions.

Invest in your team now because when the world gets going again, you will be ready!

By Thomas L. Lantz, Lantz Consulting Services

50 Lubrication Best Practices You Should Be Using Now

If you were to visit 20 different plants, you likely would find 20 different ways of managing machinery lubrication, some of which would be less than ideal. There is no need for this situation to exist. This article outlines 50 best practices that a good lubrication program should contain. These practices cover five major categories: people, methods, lubricants, hardware and problem solving. They are intended to help you minimize gear and bearing failures as well as reduce lubricant costs and lube-related downtime.

PEOPLE

1. Training

In the past, most of the individuals who oversaw the lubrication requirements of industrial plants were self-taught. Even today, there are few schools where you can obtain an education in the art and science of lubrication practices. The theory of lubrication is better served but usually by courses within other degrees. However, information on applied lubrication is available, and people charged with keeping their employer's equipment running smoothly should avail themselves of it. Oil companies continue to upgrade their training programs, and independent firms specializing in lubrication training have emerged to fill the gap. Still, maintenance organizations must make a concerted effort to educate their teams on lubrication best practices.

2. Accountability

Normally, only one person is assigned to lubrication duty in a department, so this individual must be effective. One way to ensure this is to list the duties and require checklists be followed. This work is not so much about things being put right as it is about making certain that things go well. The distinction is important. Verifying that tanks are at the proper level, grease systems are firing properly, and parts orders are placed are examples of ensuring things don't go wrong. When things do not go wrong and downtime is minimized, shortsighted management may get the idea that the workforce can be reduced. However, cutting the lube technician is like canceling your insurance. If downtime occurs as a result of a lube failure, it generally means the lube technician is not doing his or her job. At this point, an investigation must be conducted, and the person chastised or given further training. Incompetence must be weeded out, because this individual is your first line of defense.

3. Certification

Years ago, no recognition was given to people who acquired lubrication education on their own initiative. This is no longer true. Organizations such as the International Council for Machinery Lubrication (ICML) are now dedicated to give recognition to these valuable people. Certification exams are available to anyone for a fee after a minimum of experience. These exams have become quite popular and emphasize the knowledge needed by those involved in daily lubrication decisions.

4. Lubrication Committee

Most industrial plants would benefit from the establishment of a committee that is responsible for overseeing all lubrication questions, but who should participate on such a committee? Maintenance people who ultimately are charged with downtime reduction are at the top of the list, and this includes hourly workers. This latter group is a terrific source of ideas and precautions about what will and won't work. Production management should attend if only to learn the rudiments of keeping machinery in top operating condition. Their decisions should benefit from their participation on the committee.

5. Contracting Out Work

Many plants have union agreements that demand a review when outsiders are brought in to perform work. However, if specialized equipment is involved, the necessary skills are not possessed onsite or the job will be of short duration, a contractor makes sense. On the other hand, when the job will be continuous and requires a low skill level, in-house personnel likely will be the better option. If it is difficult to find motivated people who are willingly to take on the responsibility of lubricating the equipment, it may be time to consider contracting out this important function.

6. Outside Lubrication Audits

Lubrication practices in any industrial plant can become outdated and preserved due to inertia. To get a fresh perspective, it is wise to allow an outside company to examine your plant's practices for improvement recommendations. The audit may be free or at a nominal cost, but it should be done by someone with no vested interest.

7. Continuing Education

Lubrication practices do not change rapidly, but a new one will come along periodically. Technical developments change more rapidly than practices, and together they warrant regular training. All training participants should attempt to return to their job with at least one usable idea to justify the costs. This should be an easy goal to achieve.

8. Recognition of People

Lubrication technicians are the unsung heroes of industry and should be recognized. Keeping these individuals energized is important. How can one counter the management tendency to blame the lube specialist when things go wrong but give no credit when things go right? The best way is to set specific standards, such as keeping lube-related downtime below "X" per hour of production time.

GOALS	
1.	Minimize Bearing Failures
2.	Minimize Gear Failures
3.	Minimize Lubricant Costs
4.	Minimize Lube-related Downtime

9. Recognition of the Lubrication Field

Just as the people involved in lubrication tend to be forgotten, the entire field suffers the same fate. Production is king, and management's attitude often seems to be, "Don't bother me with these boring details." However, concentrating only on production eventually will cause production to suffer. Attention to the details that are crucial to production is a derivative (and more effective) way of accomplishing the same goal. Of all the specialties that industry looks to recruit, a lube specialist is the only one you can't find in a college or technical school. You must look for someone who is self-taught or has been through a training program, which makes these individuals quite rare. Even if you must hire outside contractors to perform this service, recognize that it is not something that can be picked up quickly and should be given respect.

10. Purchasing/Maintenance Relations

One of the worst situations an industrial firm can have is antagonism between the maintenance and purchasing departments. Frequently, the decision to switch to total fluid management (TFM) is made unilaterally by purchasing, ignoring the needs of maintenance. There are several ways to avoid this problem. One is to standardize lubricants instead of buying by

brand name. Another is assuring that both departments participate on the lubrication committee. Whatever method you choose, endeavor to establish good communication between these two groups.

11. Daily and Monthly Reports

No one likes paperwork, but in lubrication, it can pay great dividends not only in identifying trouble areas but also for documenting routine maintenance. Items to record include oil losses, lab tests, lube maintenance, tank level checks, bearing and gear losses, investigations, etc. Comparing losses with previous periods to demonstrate improvement is important. Photos of gear deterioration can be proactive. Keeping records of the proper lubricant to use in each piece of equipment preserves continuity. Any department that ignores paperwork and reports contains the seeds of its own destruction. The lube department should always justify its existence, since it is a necessary evil in some people's eyes.

12. Skill, Aptitude and Motivation

If you are lucky enough to have someone on staff who enjoys lubrication work and is talented at it, try to hang onto that person. These individuals are rare and deserve special treatment. Visualize them as an insurance agent for your equipment, which they truly are. They generally are self-starters and do not need much motivation. They see things that need to be done to prevent problems that others might miss. Again, look for a committed employee, not the time-server, for lube work. Avoid the alienated employee like the plague.

13. Establish Goals and Sub-goals

Even talented people must have goals to assure their efforts are productive. These goals also need to be translated into sub-goals to truly affect day-to-day activities. Periodic assessment of how you are doing will keep you on track. Never give up the practice of goal establishment or you will simply drift. Any accomplishments will be accidental if this occurs.

METHODS

14. Use Lube Specs

Purchasing lubricants on an objective basis is nearly impossible when doing so by brand name. Every manufacturer wants to differentiate its products from the competition, but almost all have a degree of interchangeability. While the details for buying lubricants based on specifications are beyond the scope of this article, 95 percent of all lubricants can be purchased this way. Suppliers also may be willing to cut prices appreciably when faced with this situation.

15. Emphasize Bulk Packages

Buying lubricants in bulk can save you money in several ways. First, suppliers can offer lower prices simply because of reduced packaging cost. Eliminating a lot of smaller packages that eventually must be disposed of can offer savings as well. The lubricant is also kept cleaner if transferred directly from the bulk package to the point of use. Finally, getting the lubricant to the point of use can cost 10 times more in labor with drums than with bulk packages. Critics claim bulk usage encourages waste due to more being available, and this can be a disadvantage if not monitored closely.

16. Consolidate Lubricants

Over time, as new equipment is brought into a plant and lubricants are purchased, it is inevitable that several identical products with different brand names may find their way into inventory. By encouraging personnel to think in terms of performance specifications instead of brand names, you can make lubricant consolidation easier. Fewer products mean less confusion, fewer mistakes and the opportunity to lower costs through larger purchases.

17. Survey Sheets for All Equipment

Every piece of plant equipment should have its own listing of lubricants and lube points. This information may be stored on a computer and accessed from anywhere. These survey sheets comprise the plant's "book" on lubrication and ensure continuity over time. They also assist in consolidation efforts. Not using this system encourages a free-for-all among departments and undermines the idea of a central lube authority.

18. Routing Sheets

With larger plants and illogical equipment layouts, routing sheets assist new personnel in assuring nothing is forgotten. These sheets also allow someone to design the routes for best efficiency. As plants continue to operate with fewer personnel, making good use of one's time helps the bottom line.

19. Portable Condition Monitoring Equipment

As most equipment for condition monitoring has been miniaturized, personnel can now take vibration and temperature readings with a handheld computer and analyze it back at the office. This is a great timesaver. Portable oil analyzers are becoming more dependable for field work. Sending samples to a lab may be reserved for more critical and costly items. Common condition monitoring technologies include infrared thermography, ultrasonics, oil analysis, vibration analysis and acoustic emission.

20. Lube Sampling

If your plant has costly equipment that depends on a charge of high-quality oil, lube sampling (including new shipments) should be part of your routine, regardless of the size of your plant. This should be done regularly so trends can be monitored. Wear and contamination control are important for most equipment. If outside

lab work becomes too costly, consider the portable equipment mentioned above. In addition, checking new lube shipments for compliance with performance specifications will help keep your suppliers honest and careful.

21. Use Barcodes

You can enhance your lube program by attaching barcodes to various points of inspection and providing technicians with a handheld reader and computer. Valuable information from the site, such as the tank level, temperature or oil additions, can be fed to a central site for decision making. These devices help to ensure inspections are completed and eliminate paperwork.

22. Control Oil Losses

Oil losses can be a considerable expense for some plants. These losses should be recorded per hour of operation, not by unit of production. The reason for this is that productivity improvements can give the impression that oil loss corrections have been made when they have not. Remember, the cost of tolerating oil losses generally is more extensive than most people imagine.

23. Management of Usage

A critical aspect of usage management is the control of buying by a central authority. This may be a maintenance individual, committee or purchasing agent, but multiple buying sources must be discouraged. Decisions made by several people in any facility can cause product proliferation, outrageous pricing and less than ideal equipment protection. While the purchasing department will influence the decisions, it must not dominate the central authority.

24. Filter-Fill Hydraulic Systems

Contamination is the primary reason for hydraulic problems throughout industry, with ingressed contaminants by far the dominant cause. Ingressed contamination means contaminants have entered the system by sloppy workmanship, accident or sabotage. Simply insisting on good filtration is not enough. Instead, you should filter-fill all of your hydraulic systems.

25. Coordinate with the Engineering Department

The majority of individuals responsible for machinery lubrication are associated with the maintenance department. Engineering departments normally are charged with acquiring new equipment and keeping installation costs within budget. Sometimes, the goals of these departments conflict. Therefore, these groups must learn to communicate and not work at cross-purposes. New equipment purchases are legitimate discussion topics at lubrication committee meetings, and these decisions can benefit by engineering department representation.

26. Price TFM Separately

Due to the loss of personnel qualified in lubrication skills, oil companies have attempted to fill the gap by offering the same services with the purchase of their products. Any necessary management costs usually are covered by increasing the product costs. Some companies offer total fluid management (TFM) services for a fee with all or most lubricants purchased from a third party. If a company offers to perform this service for you, their management fee should be priced separately, not factored into the product price. Pricing TFM services separately will allow management to see what their decision is truly costing.

27. Computerized Specs

All lubricants in use should have a material safety data sheet (MSDS) on file and available on any office computer throughout the plant. The same should be true for the performance specifications of all lubricants. Keeping these specifications on file for all to see will teach maintenance personnel to focus on the specs, not brand names.

COMMON CONDITION MONITORING TECHNOLOGIES

Infrared Thermography	Ultrasonics
Ferrography	Particulate Analysis
Oil Analysis	Chromotography
Vibration Analysis	Thermogravimetry
Acoustic Emission	Shock Pulse Analysis

LUBRICANTS

28. Use Color, Alphanumeric Codes

A system must be devised that places the lubricant in a well-recognized category of generic products. Alpha-numeric seems to be the most common, although shaped symbols with different colors are popular. The system selected must be well-publicized and understood by the lube technicians. Charts may also be needed around the plant.

29. Inventory Management

Establishing re-order points for lubricants is important, but just as critical is a system that keeps computerized control and insists on verification by sight. In other words, don't depend totally on the computer. The storage method should ensure that first-in/first-out (FIFO) practices are employed and that drums are protected from the elements. A designated area that is well lit and clean conveys the message that lubricants are to be cared for in a prescribed manner. Signs specifying where each lubricant is to be stored are a must.

30. Vendor Competition

Competition is key when buying lubricants on specifications. Once the specs are written, all vendors who so desire should be allowed to bid, unless there are extenuating circumstances. The lowest bidder must be awarded the business for the designated

time period. Failure to do this will decrease the number of vendors in the next bid cycle, because word will get around that someone is receiving favored treatment. However, price should not be the only consideration. Delivery, expertise and response to problems are important, too.

31. Demand a Clean Storage Area

Nothing distresses a good lube engineer like a dirty, disorganized lubricant storage area. These conditions imply a lack of care for the machinery. A clean area conveys the message that the equipment must be well cared for or consequences will follow. Psychologically, attitudes improve, and people will be influenced to regard lubrication as the important function it is.

32. Emphasize Oil Where Possible

With apologies to grease manufacturers, if you have a choice, oil is the preferred option for most applications. Oil does a better job of cooling bearings and gears, and can carry dirt away better. While grease also has its advantages, it can be more of an environmental hazard due to the practice of "lubri-flushing" or overgreasing bearings to flush out dirt.

THE TWELVE COSTS OF TOLERATING HIGH OIL LOSSES

1. Initial cost of replacement
2. The costs of catching the leakage
3. The cost of waste oil disposal or re-use
4. Environmental costs
5. The costs of moving extra drums around plant
6. Extra drum disposal costs
7. The costs of cheapening the lubricant to save
8. The cost of extra labor to keep equipment filled
9. The cost of shorter equipment life due to poor maintenance-in-service
10. Cost of shorter equipment life due to empty reservoirs
11. Cost of substituting "next best" lube in crisis
12. Housekeeping and related safety costs

33. Continuously Review Lubricants

One of the primary duties of the lubrication committee should be to continually review the list of lubricants in use. This will assist with your consolidation efforts and to ensure that 80 percent of applications are being served by 20 percent of the lubricants on the list. It also will help confirm that the supplier has not modified the specifications and that the lubricants you are receiving match these specs.

HARDWARE

34. Use Automatic Lube Systems

The typical industrial plant has so many lube points that relying on manual labor can be expensive and unreliable. Automatic systems are available to do almost any lube job with a minimum of attention. Not using this technology can also be dangerous to workers, as automatic systems allow lubrication during operating periods without requiring a person to get close to the equipment. Designs are available to fit nearly any application. The use of grease guns should be reserved for electric motors, isolated bearings, mobile equipment or the extremely difficult-to-access bearing.

35. Electric Alarms on Gravity Oilers

Bottle oilers tend to be forgotten unless routing sheets are used. If this has been a problem, consider employing units with electric alarms that generate a signal when they are empty.

36. Use Gun-filler Pumps

As desirable as automatic grease systems are, there are applications where the use of grease guns is justified. However, the way these guns are filled can be controversial. It is recommended to avoid the use of grease tubes because they are expensive and require the gun to be opened for filling, thus admitting dirt. Discarding a tube also becomes an environmental hazard. Every gun has a connection for pressure filling, which should be used. Gun-filler pumps fit over a grease drum with a special cover. Simply attaching the gun to the fitting on the pump and stroking the pump handle will quickly fill the gun without having to open it and without requiring a garbage can to be located for the old tube.

37. Filter Oil and Grease Deliveries

For all bulk deliveries, the plant's bulk tank should have some filtering arrangement to verify the cleanliness of the supplier's truck. A 25-micron filter for oil and a 100-mesh strainer for grease should be adequate. Any increase in element change frequency should generate questions for the supplier. This practice will also eliminate the need for standalone filter systems to supplement oil storage tanks as well as the expensive practice of buying "super-clean" oil in portable bulk tanks, which is contaminated the minute the lid is loosened.

38. Drip Pans Under Drums

The Environmental Protection Agency (EPA) requires a plant's in-service oil drums be set in pans to contain any drips or leakage. For the typical plant, this can be a hardship and a further reason to eliminate drums in favor of bulk containers. Of course, totes containing several drums' worth of oil must also be protected. Drums should be on horizontal cradles that have provisions for uprighting the drum if necessary. Once opened, the drums should have self-closing spouts inserted in the large bung and a breather in the small bung. After use, the drums must be disposed of in a proper manner.

39. Eliminate Filler Breathers

Filler breathers are those familiar devices inserted in the top of hydraulic tanks which

combine the functions of a breather and a strainer through which make-up oil is poured. This device is the hydraulic repair shop's best friend, as it is responsible for more dirt entering a hydraulic system than any other. Make-up oil should never be poured into a hydraulic system because eventually the mechanic will use a dirty container. Also, the screen that hangs down into the reservoir often becomes clogged, which may result in the mechanic punching a hole through the screen to make the oil flow better. All oil added to a system should be pumped in through a filter. While every tank needs a breather, that should be its only function.

40. Onsite Test Equipment

Most industrial plants cannot justify the expense of having their own test lab for oil samples. However, there are a few tests that may be conducted economically onsite. When time is of the essence, consider checking for water in recirculating lube systems with benchtop centrifuges or distillation devices. A case could also be made for testing the dirt content in critical systems, although this is a cheap test, and results can be phoned in from an outside lab if necessary.

41. Onsite Repairs

Whether to repair or buy a new piece of lubrication hardware is a question every maintenance department may face. Most maintenance personnel like to prove they can get something operating again, and if the component fails often enough, they may create a small shop to continuously make the repairs. Be careful in setting up these little shops or adding people to old ones. Sometimes you must step back and ask, "Why are we doing this?" Perhaps buying a new part would be best. Do not assume that repairing it in-house is a good idea.

PROBLEM SOLVING

42. Use a Systematic Problem-Solving Routine

Most industrial problem solving consists of trying something, and if that doesn't work, trying something else. Typically, the tried solution focuses on one area, forgetting that most problems could have multiple causes. The first thing to know about any problem is that the symptoms can distract you from the true cause. You must learn to distinguish between symptoms and causes. Symptoms are the things you see, like the excessive heat from a hydraulic system. Poor problem solvers focus on the heat and install additional heat exchangers, while the good problem solver asks the question, "What is causing this heat?"

43. Root Cause Analysis

Even though cause-and-effect problems are only one of four major problem types found in an industrial plant, they are the ones that cause more consternation than all the others. The term "root cause" implies that the immediate cause may not be the ultimate cause. You must dig deeper to find the root cause. The best question to ask in this situation is why or what caused this issue. Rather than stop at the first answer to this question, ask what caused it and then proceed backward. Sometimes the causes are in a long string and may surprise the problem solver, but there will be a point where a solution will be most effective and practical. That is the place to apply your efforts at cause correction.

44. What Has Changed?

One of the critical questions that must be asked in any cause-and-effect problem investigation is, "What has changed?" This question implies that if everything was running well for a long time and suddenly there was a problem, something must have changed. Otherwise, things would still be running smoothly. The Kepner-Tregoe method advocates using this question relentlessly until the thing that changed is found. The question has its greatest value in machinery questions or production situations.

45. How Do Bearings and Gears Fail?

Of the many ways that bearings and gears can fail, only a few of which are lube related. All too often, the lubricant is blamed, but the best lubricant in the world cannot make up for poorly made, maintained or installed components. Investigate gear and bearing failures as you would any other problem, with no preconceived notions. Use a rational approach, and you may be surprised how

many times the cause is mechanical and not lube related.

46. Condition Monitoring

Good lubrication specialists always have their antennae up anticipating problems. Condition monitoring allows you to do just that. Common technologies in this field include infrared thermography, ultrasonics, oil analysis, vibration analysis and acoustic emission. Many companies find it helpful to employ outside contractors to conduct certain tests and have their staff perform others. The field is growing, and one would be wise to explore the potential benefits.

47. Continuous Improvement

Every lubrication committee should have a list of the current projects for improving equipment life or minimizing costs. This list should be on the agenda of each meeting, with the progress noted in the meeting report. In the absence of a committee or with an individual working alone in the lube program, a project list can help to multiply the individual's effectiveness. No item on the list should be ignored. If it makes it on the list, either work on it or remove it. The concept of continuous improvement concentrates the mind and prevents drift or simply reacting to problems. It also convinces management that while no bad things requiring corrective action are currently happening, there is a verifiable cause of this wonderful state of affairs.

48. Four Types of Problems

While cause-and-effect problems are most common in industry, there are three other types that must not be ignored, namely identification, means and ends. Identification problems usually start with the question, "What is that?" Variations on this are questions of when, where, who and how much. Seeking a solution to a causal problem without first solving the identification problem will lead to trial and error. Means problems or "how can I accomplish that?" often arise when trying to implement a solution. Variations include "What should I do next?" or "Which method should I select?" Problems of ends or goals usually are determined for the problem solver by someone higher up, but this doesn't preclude him or her from thinking about the goals. Standing back and asking, "What am I trying to accomplish?" can be productive and appreciated by the boss later.

49. Record Lost Bearings

This is not to suggest that you should try to record every loss, but even this might be achievable if your bearings are supplied by a single vendor and your computer records can provide information in a point-of-use format. Because a bearing may be used in many locations, purchasing by location may help pinpoint localized trouble. Once the most difficult bearing locations in the plant have been identified, watch those more closely for unusual activity.

50. Record All Lube-related Problems

Quite often, lubricants are blamed for problems unfairly. Breakdowns are generally recorded in some fashion, and the wording may imply a lubricant cause. The prudent lube specialist will investigate all of these thoroughly. Persistent problems should be on the lubrication committee's meeting agenda until resolved. To counter the blame game, let it be known that every incident will be thoroughly investigated, and no person's opinion will stand unchallenged. Another reason for recording these incidents is to have a record of improvement to show upper management. The benefits of this approach can be powerful. ***ML***

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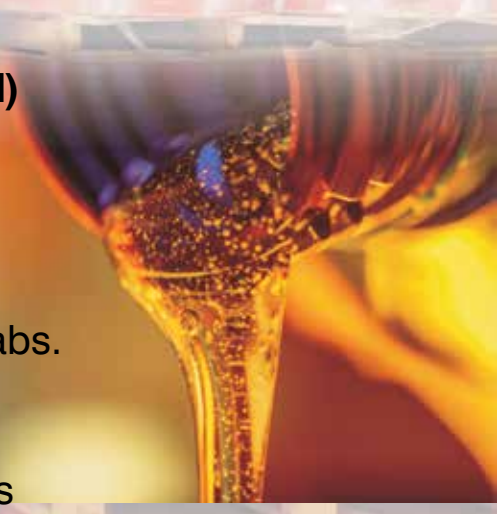

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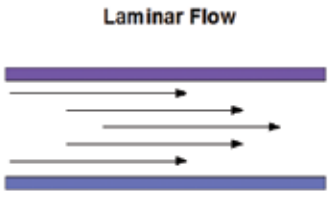
Why You Shouldn't Overlook **Hydraulic Pipe Size**

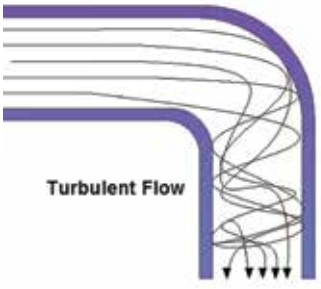
Unfortunately, the increased flow often exceeds the capability of at least some hydraulic lines.

Rarely do I encounter a hydraulic system that has never been modified in some way over the years. Usually modifications have been made either to make the system run faster or to add some functionality to the machine. Either way, more flow is normally required, which means the pump must be upgraded to a higher displacement. Unfortunately, the increased flow often exceeds the capability of at least some hydraulic lines.

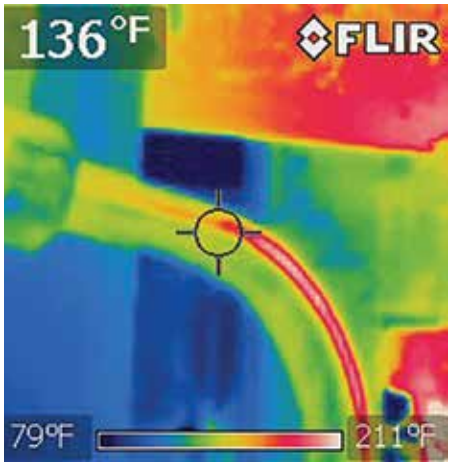
Hydraulic lines that are too small cause excessive heat and turbulence, ultimately resulting in system damage and fluid degradation. Whenever the system is upgraded to increase its flow, it is important to ensure that current line size is enough to handle the increase.

Heat and turbulence caused by undersized lines is the result of excessive fluid velocity. Fluid velocity is inversely proportional to line size. Any increase in flow will lead to an increase in fluid velocity. This isn't much of a problem in a line that is straight. Imagine the fluid being on a molecular level. If all the molecules of the hydraulic fluid are traveling parallel to each other, you have a condition known as laminar flow.

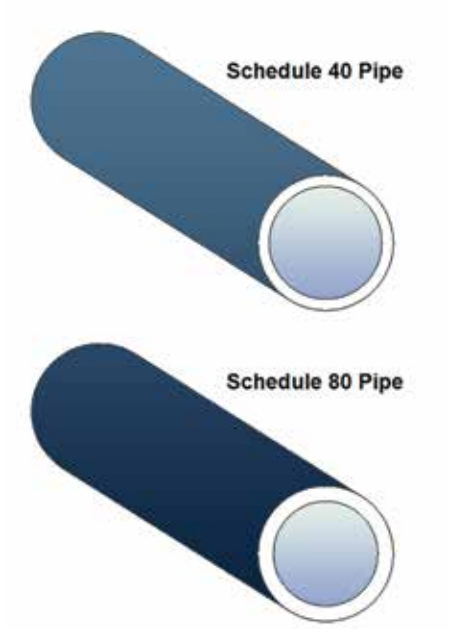




Laminar flow is the most efficient form of flow and the form that all flow seeks to become. Naturally, the fluid in the center of the line will move somewhat more rapidly than the fluid at the edges because



This thermal image shows a hot spot in the bend of a pipe.



of friction with the walls, but the resulting temperature gain will be negligible in a line that is straight. The trouble comes when the fluid reaches a bend in the pipe, as illustrated to the right.

The molecules then begin colliding with the sides of the pipe, causing the laminar flow to become turbulent flow, and heat is generated. It usually is quite easy to tell when the line diameter is too small by measuring the bends in the pipe with a thermal imaging camera. Hot spots at the bends are a dead giveaway.

Pipe Size (Inches)	SCHEDULE 40 PIPE					
	GPM@ 2 ft./sec.	GPM@ 5 ft./sec.	GPM@ 10 ft./sec.	GPM@ 15 ft./sec.	GPM@ 20 ft./sec.	GPM@ 25 ft./sec.
1/8	.35	.89	1.8	2.7	3.5	4.4
1/4	.65	1.6	3.2	4.9	6.5	8.1
3/8	1.2	3	6	9	12	15
1/2	1.9	4.8	9.5	12	19	23.8
3/4	3.3	8.4	16.7	25.1	33.4	41.8
1	5.4	13.5	27	40.6	54.1	67.7
1 - 1/4	9.4	23.4	46.8	70.3	93.7	117
1 - 1/2	12.7	31.9	63.7	95.6	127	159
2	21	52.5	105	157	210	263
2 - 1/2	30	75	150	225	300	375
3	46.3	116	232	347	463	579

Table 1. A sample schedule 40 pipe chart.

Pipe Size (Inches)	SCHEDULE 40 PIPE					
	GPM@ 2 ft./sec.	GPM@ 5 ft./sec.	GPM@ 10 ft./sec.	GPM@ 15 ft./sec.	GPM@ 20 ft./sec.	GPM@ 25 ft./sec.
1/8	.35	.89	1.8	2.7	3.5	4.4
1/4	.65	1.6	3.2	4.9	6.5	8.1
3/8	1.2	3	6	9	12	15
1/2	1.9	4.8	9.5	12	19	23.8
3/4	3.3	8.4	16.7	25.1	33.4	41.8
1	5.4	13.5	27	40.6	54.1	67.7
1 - 1/4	9.4	23.4	46.8	70.3	93.7	117
1 - 1/2	12.7	31.9	63.7	95.6	127	159
2	21	52.5	105	157	210	263
2 - 1/2	30	75	150	225	300	375
3	46.3	116	232	347	463	579

Table 2. Another example of a schedule 40 pipe chart.

The schedule of the pipe influences turbulence as well. Most systems require schedule 40 pipe for suction and return lines but schedule 80 or 160 pipes for pressure lines, depending on the system pressure. The higher schedule pipe has thicker walls to contain the force of the higher pressure, thus the higher schedule pipe has a smaller inside diameter. Although the pipe may look the same on the outside, the fluid velocity will be higher through a greater schedule pipe.

For most systems, turbulence can be kept to an acceptable level using the following guidelines:

Pipe Size (Inches)	SCHEDULE 80 PIPE					
	GPM@ 2 ft./sec.	GPM@ 5 ft./sec.	GPM@ 10 ft./sec.	GPM@ 15 ft./sec.	GPM@ 20 ft./sec.	GPM@ 25 ft./sec.
1/8	.23	.57	1.1	1.7	2.3	2.8
1/4	.45	1.1	2.2	3.4	4.5	5.6
3/8	.88	2.2	4.4	6.6	8.8	11
1/2	1.5	3.7	7.3	11	14.7	18.3
3/4	2.7	6.8	13.6	20.3	27.1	33.9
1	4.5	11.3	22.5	33.8	45	56.3
1 - 1/4	8	20	40.1	60.2	80.3	100
1 - 1/2	11.1	27.7	55.3	83	110	138
2	18.5	46.2	92.5	139	185	231
2 - 1/2	26.5	66.4	133	199	265	332
3	41.4	103	207	310	414	517

Table 3. A sample schedule 80 pipe chart.

Pump Suction Lines

Most hydraulic pumps have a suction line that is larger than the pressure line. This is because the inlet velocity must be very low to allow fluid to freely flow into the pump. Any restriction of inlet flow will cause the pump to cavitate and ultimately destroy itself. A pipe, tubing or hose chart can be used to determine the proper diameter pipe. These charts should be available from the manufacturer. Since a schedule 40 pipe would be required for a suction line, use the sample schedule 40 pipe chart in Table 1 to size the line.

In this example, let's assume the system pump has been upgraded to one that delivers 30 gallons per minute (GPM). Since you do not want to exceed 5 feet per second, look down the 5 feet per second column to find the flow rate. Notice that a 1¼-inch pipe can handle up to 23.4 GPM without exceeding a fluid velocity of 5 feet per second, while a 1½-inch pipe can withstand 31.9 GPM. Whenever your flow rate is between two sizes, always pick the next larger pipe size, not the next smaller one. Therefore, if the existing line were smaller, you would install a 1½-inch suction line.

Return Lines

Since you can also use schedule 40 pipe for a return line, you can check the schedule 40 chart again to determine the proper pipe size.

By looking in the 15 feet per second column of Table 2, you find that a 1-inch return line can deliver up to 40.6 GPM without exceeding 15 feet per second fluid velocity. You therefore would choose at least a 1-inch schedule 40 return line.

Pressure Lines

Most hydraulic systems operate at less than 3,000 pounds per square inch (psi) and can use schedule 80 pipe for pressure lines. However, some systems operate at much higher pressures and require heavier piping. Usually systems that operate at more than 3,000 psi have very rigid design specifications and seldom get modified much. The designer should pay close attention to pipe size and specify the number of allowable bends as well as the necessary radius of any bends. Often such machines are designed to allow for fluid velocities of 30 feet per second or more.

If the operating pressure is less than 3,000 psi, you may use a schedule 80 pipe chart to size the pipe. By checking the 20 feet per second column of Table 3, you can see that a 1-inch schedule 80 pipe can deliver 45 GPM without exceeding a fluid velocity of 20 feet per second.

Always Check Your Lines

Don't ignore the size of your hydraulic pipes. Size does matter. Before upgrading your systems, always check to be sure the lines are the right size. Also, if excessive heat or turbulence are suspected, use a thermal imager to look for potential hot spots. ***ML***

About the Author

Jack Weeks is a hydraulic instructor and consultant for GPM Hydraulic Consulting. Since 1997 he has trained thousands of electricians and mechanics in hydraulic troubleshooting methods. Jack has also taught radio-wave propagation for the U.S. Air Force and telecommunications equipment operation and repair for the Central Intelligence Agency at American embassies overseas.

Anshuman Agrawal | Minimac Systems Pvt Ltd

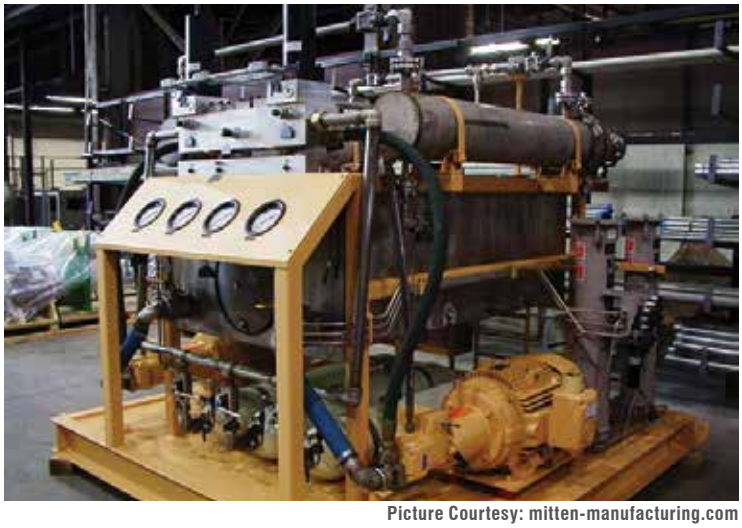
CASE STUDY

Maintenance of FRF in turbine EHC system

"The purpose of the article is to sensitize the reader about FRF Maintenance and to adopt best practices from the industry."

What is a Turbine EHC system?

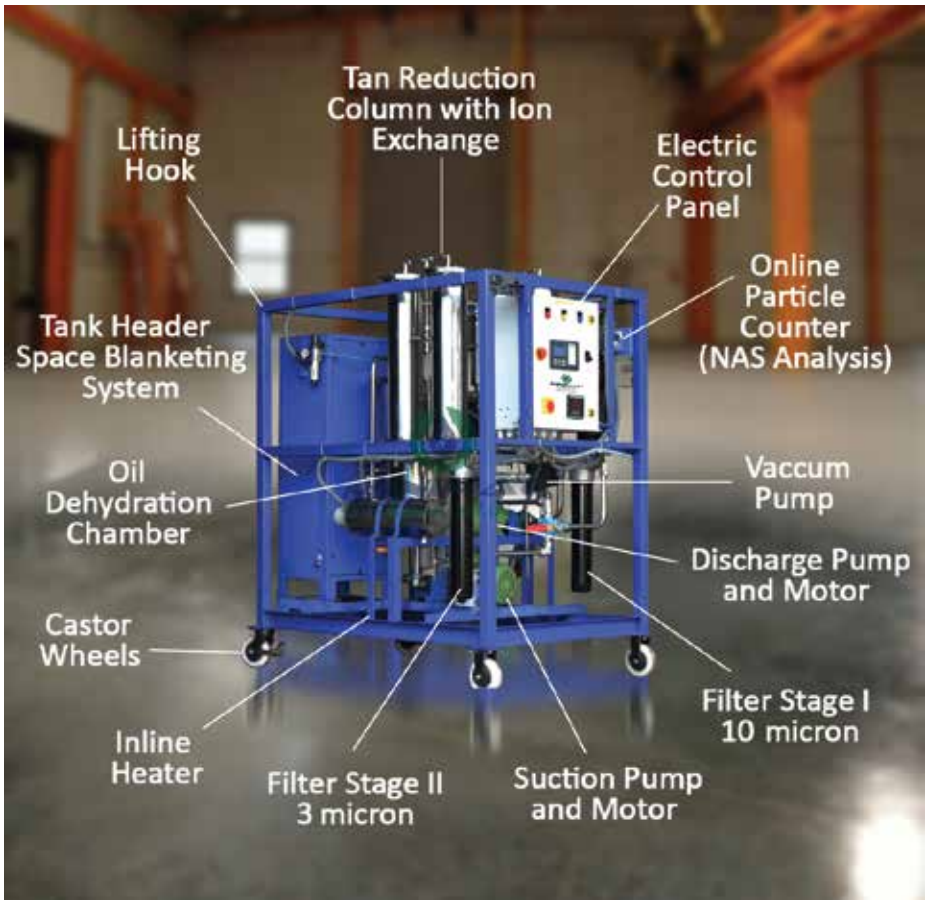
Electro-Hydraulic Control System (EHC System or the DEH System) of a Turbine is the most critical equipment of a Power Plant. It's the heart of a turbine which controls Steam flow into the turbine. A malfunctioning EHC System can lead to Turbine stoppage and thereafter create a dominoes effect on the synchronized processes of the power plant. Breakdown-free and reliable operation of the EHC System is the biggest challenge of the O&M Manager and Engineers.



Picture Courtesy: mitten-manufacturing.com

Due to High Steam Pressure & Temperature in the vicinity of a Steam Turbine, as a safety compliance, it is a mandate to use Fire Resistant Fluids (FRF) for Hydraulic control of the EHC System. A specially designed synthetic fluid called Tri-Xylenyl Phosphate Ester (TXP) demonstrates best Fire Resistant properties for the application.

Phosphate Esters are polar fluids with excellent lubricating properties that can operate under extreme conditions. However, it requires strict control in order to extend their useful lifespan. This article covers best practices for strict



maintenance required to prevent the untimely destruction of phosphate ester fluids.

Water and acids de-grade FRF

Phosphate Esters are manufactured under controlled environment through esterification of Phosphoric Acid, where water is a by-product.

Phosphoric Acid + Alcohol → Phosphate Ester + Water

Unfortunately, Phosphate Esters are highly hygroscopic (tendency to absorb water) and the esterification process is reversible when Phosphate Esters come in contact with water. This is called ester hydrolysis. The higher the water content and temperature, the faster ester will break down by hydrolysis.

Phosphate Ester + Water → Phosphoric Acid or Acid Phosphates + Alcohol

Thereby it is recommended to control water level, temperature and acidity in FRF of the EHC Systems. If not controlled efficiently, the acidity accelerates rapidly.

Total Acid Number (TAN) is a parameter to denote acid content accumulation in FRF. A high TAN Value degrades the fluid rapidly, decreases its viscosity and resistivity. Thereby causing acid corrosion of sensitive servo-valves and other system components of a EH System.

FRF de-gradation due to particles

Water and acid are not the only contaminants which can degrade the FRF. Since the dynamic oil film and fine clearances in servo-valves are less than 5 microns, even the finest silt particles and sludge/varnish deposits from fluid degradation can hinder proper operation. Fine particles get trapped in clearances between the valve plunger and housing. This abrasive wear is known as seizing or grinding which results in wear rates that are a thousand times greater than anticipated by the valve manufacturer.

Therefore, it only makes sense to use very fine filtration (3-5 micron) for maintaining the EHC fluid.

Consequences of FRF de-gradation

- Acid, gel and sludge/varnish formation
- Valve sticking or blocking
- Reduced lubricity and film strength
- Corrosion, erosion and abrasion wear
- Reduced fluid resistivity
- Soot generation (entrained air)
- Short fluid life

The result is poor EHC system reliability and reduced turbine availability.

Condition based monitoring of FRF

It is highly recommended to carry out regular Fluid Analysis of FRF and identify any abnormalities in the trend for further preventive actions.

Recommended Parameter Values for FRF:

Parameter	Unit	Value
Appearance	ASTM Color	Clear, < 3
Water Content	ppm	< 500
Kinematic Viscosity (at 40 degree Celsius)	cSt	±10%
Acidity (TAN)	mgKOH/gm	<0.15

Particulate Contamination	ISO 4406	<15/12
Cleanliness Code	NAS 1638	<5

EH OIL / FRF conditioning system

In order to have complete purification of FRF, an external FRF Reconditioning System is recommended comprising latest technologies to meet following functions:

- Solid contamination Super-fine Filtration
- Moisture in oil separation by Vacuum Dehydration technology
- TAN reduction by Ion Exchange technique
- EHC System Tank Moisture Removal by Inert Gas Blanketing technique

Removal of Solid Particles from FRF

Removal of Solid particle contamination in FRF fluid should be carried out by usage of stage-wise Superfine Mechanical Filters (upto 1 micron, Beta 1000 rating) ensuring results better than NAS 4/5.

Moisture Separation from FRF

As FRF is hygroscopic in nature, water is mostly present in dissolved form. OEMs of EHC Systems often provide water absorbing filters. However, these fail to absorb the dissolved moisture content. Vacuum Dehydration technology is safe and recommended by FRF manufacturers for efficient separation of moisture / water in FRF.

TAN Reduction in FRF

OEMs of EHC Systems commonly provide Fuller's Earth and Activated Alumina (Selexorb®) cartridges for maintenance of Low TAN value in FRF. However, TAN values in FRF is frequently reported beyond 0.2 values in most of the cases.

Technology of FRF regeneration and re-conditioning using special Weak Base Anion (WBA) resins under Ion Exchange method should be opted which has been successful for over 25 years in Europe and America.

Tan reduction success stories in India's power plant

Multiple Power Plants in India are facing the trouble of maintaining desired operational parameters of FRF. Below are results of successful cases of Indian Power plants where FRF Re-conditioning System has helped them in FRF Re-generation.

Case 1: A super critical power plant in Northern India using Indo-Japanese Technology Turbine EHC System

Date	Moisture	TAN
12.07.2017	860	1.83
17.07.2017	259	1.51
27.09.2017	784.3	0.53
13.10.2017	<500	0.20

Case 2: A power plant in Southern India using Chinese Technology Turbine DEH System

Date	Moisture	TAN
28.02.2015	331	0.96
30.11.2015	302	0.20

Case 3: A super critical power plant in Northern India using Chinese Technology Turbine DEH System

Date	Moisture	TAN	NAS
Unit 1			
26.04.2018	333	0.57	5
21.05.2018	205	0.14	4
Unit 2			
29.03.2018	329	0.40	5
24.04.2018	371	0.13	4

Case 4: A coastal power plant in Western India using Chinese Technology Turbine DEH System.

Date	Moisture	TAN
01.10.2016	high	0.81
10.11.2016	572	0.56
10.03.2017	<500	0.14

Case 5: A power plant in Central India using Korean Technology Turbine EHC System

Date	Moisture	TAN
05.12.2016	N.A.	0.40
29.12.2016	<500	0.04

The purpose of the article is to sensitize the reader about FRF Maintenance and to adopt best practices from the industry. The data presented in the article has been researched over technical papers, presentations and the field performance results as observed at various power stations. None of the names have been revealed due to NDA compliances.

About the Author

Anshuman Agrawal is Managing Director of Minimac Systems Pvt Ltd. He holds Engineering Degree in Machineries (Mechanical) from IIT Dhanbad and an Executive MBA from IIM, Indore. He carries 15 years of vast industry experience in the field of lubrication and hydraulics reliability. He is also a certified MLT-1 from ICML, USA and MLE trained from Noria, USA. Contact him at *anshuman@minimac.in*

GREAT PIONEERS
THAT INSPIRE US

At Machinery Lubrication India, we constantly endeavor to enhance the content of our publication. Keeping in mind the interest of our subscribers, we have started a special section last year - 'Great Pioneers that inspire us'.

We have great pioneers who made a profound impact on industry and academia with their works, inventions, research and writings. One of them is Dr. Ernest C. Fitch. His knowledge and vision have been an inspiration to many. He has made a mark in the fields of tribology and fluid power. In this section, we will look at the life, the challenges and the achievements of Dr. Fitch, one of the most outstanding pioneers of all-time.

Dr. E. C. Fitch began his engineering career as a journeyman machinist before entering the military in World War II. After receiving his Master of Science degree in mechanical engineering from Oklahoma State University (OSU), He set out to gain practical experience by taking jobs with Jersey Production Research, Boeing Aircraft, Deere and Company, Cincinnati Milacron and Cessna Fluid Power.

During his 35 years on the faculty of Oklahoma State University, he advised more than 100 doctoral and master degree students and countless undergraduate students. In order to provide a hands-on research opportunity for his students, he started a contract research center in 1956 that became the Fluid Power Research Center (FPRC). At least 160 industrial companies and governmental agencies sponsored research that provided financial support for his students.

For 18 years, Dr. Fitch headed teams of research engineers in developing hundreds of test procedures relating to tribology, contamination control and fluid power. Many of these procedures have since become national and international standards.

TIMELINE

- **1924** Born on 30 November
- **1943** Started his career
- **1956** Started a contract research center at OSU
- **1958** Awarded an Air Force research contract
- **1962** Wrote a report entitled "A Basic Science Program in Filtration Mechanics"

Dr. Ernest C. Fitch

Pioneer, Educator and Mentor in Fluid Contamination Control

Dr. Fitch had an ambitious professional goal of documenting the knowledge he had been instrumental in developing for his beloved fluid power field.

THE BEGINNINGS

In the spring of 1958, Dr E C Fitch was awarded an Air Force contract to study fluid contamination in aircraft hydraulic systems for Tinker Air Base in Oklahoma City. He began the program by conducting a major literature research study in the field. His involvement in this work was interrupted by a sabbatical leave to complete his Ph.D. at the University of Oklahoma. Upon his return to Oklahoma State University (OSU), the Air Force awarded him a new contract that continued its research sponsorship for the next nine years. With this support, He gained factual knowledge of contamination control and hands-on, real world experience on many different systems at various Air Force bases. According to him, this proved to be an unusual opportunity to acquire an unbelievable background that served him well throughout his lifetime of work in the field of fluid contamination control.

Another important event relates to a report he wrote in November 1962 entitled "A Basic Science Program in Filtration Mechanics". The National Aeronautics and Space Administration (NASA) in Huntsville, Alabama received a copy of this bulletin and offered to sponsor a six-year research program on the subject. This resulted in the establishment of the Basic Fluid Power Research (BFPR) Program, which lasted until He retired. NASA encouraged him to investigate various test procedures in contamination control that were relevant to the capture and retention of particulate matter in hydraulic systems. Between the NASA and Air Force research studies, a tremendous amount of spin-off subjects of special interest to his BFPR sponsors were discovered and published. As graduate advisor in mechanical engineering, in June 1966 he graduated his first doctoral student in contamination control, Roger H. Tucker, followed shortly by Robert Bose and Ross M. Stuntz, with many others in the pipeline.

BIG ACHIEVEMENTS

During his career, Dr. Fitch co-founded several companies providing services relating to hydraulics, tribology and contamination control. Two of these companies continue on today under the administrative leadership of his daughter, Paula Fitch and his former student, Dr. I. T. Hong, who is the CEO.

He has served on more than 250 consulting projects, nearly 200 court cases and has written more than 210 technical articles and 20 books. Dr. Fitch has been awarded 16 U.S. and 15 foreign patents and has five patents pending. From the 1960s through the 1980s, he has served as editor-in-chief of three international technical journals.

Dr. Fitch was Emeritus Professor of mechanical and aerospace engineering at OSU. He had received 15 major honors and awards from state, national and international professional organizations. Some of the most notable include:

- Wonders of Engineering Award by Society of Professional Engineers
- Distinguished Educational Leader by Fluid Power Society
- Named SAE Fellow for his leadership in standards work
- National Achievement Award by the National Fluid Power Association

1966 Published his first book on Fluid Power. Graduated his first doctoral student.

1969 His laboratory got its identity as 'Fluid Power Research Center'

1973 Served many standards committees in the US and then later internationally

1978 His Multipass Filtration Performance (ISO 4572) test standard got approved

2011 Died on 16 March at the age of 86

- Awarded Honorary Professorship, Huanghong University of Science and Technology, Wuhan, China
- Named Distinguished Professor in mechanical engineering for 11 years by the OSU Board of Regents and Faculty, until his retirement
- Hall of Fame recipient at Oklahoma State University Alumni Association

A GREAT MENTOR AND MOTIVATOR

In June of 1969, the U.S. Army initiated its contamination program with the BFPR, which ran for more than 10 years and culminated in the development of several hundred test procedures, many of which are in use today as NFPA, ANSI and ISO standards. At this point, He decided his laboratory needed an identifiable name to represent his work. In September 1969, the university approved the new name as the Fluid Power Research Center. Dr. Fitch traveled extensively during his career including India in 1977. Many of his foreign students were from India.

He served on many standards committees in the United Sates (NFPA, SAE, ASTM, ANSI) and then later internationally (ISO, BSI, NATO, Hydravlika, CETOP). He submitted many proposed test procedures originally developed at the Fluid Power Research Center (or at least those in which we had direct involvement). A few of the most recognizable includes:

- Fluid Sampling – ISO 4021
- Bottle Cleanliness – ISO 3722
- Particle Counter Calibration – ISO 4402
- Multipass Filtration Performance (Beta Rating) – ISO 4572

He authored more than 20 books, out of which his book named Fluid Contamination Control (FCC) has been his all-time best seller. The four editions of FCC have presented answers to many of the questions engineers and maintenance professionals have had with respect to contamination control. It would have been impossible to write such a book without the research conducted by the FPRC. As a result, the seminars he presented using these editions reached thousands of attendees around the world. The fifth edition of this book is currently under construction by his son, Jim, and was mostly completed at the time of his death.

DID YOU KNOW...?

- Dr. Fitch personally initiated nine graduate level courses in fluid power and his program produced several hundred fluid power engineers
- Dr. Fitch served as U.S. delegate to ISO for more than ten years
- For 18 years, Dr. Fitch headed teams of research engineers in formulating and developing 376 component/system performance/service life test procedures
- He has had more than 250 consulting engineering assignments, 162 court cases (both liability and patent infringement cases)
- He has served as member and chairman of half a dozen standards committees including SAE, ANSI, NFPA and ISO.

The three generation picture (Circa 2008) featuring Dr. E C Fitch with his son Jim Fitch, Founder & CEO, Noria Corporation and grandsons Tom Fitch, CEO, Luneta LLC (Right) & J. Bennett Fitch, Director of Product Development and LPD Services, Noria Corporation (Left). Dr. Fitch and his wife, Janette, also had two daughters, Donna and Paula.

Condition Monitoring of Gear through Oil Analysis

Laboratory Analysis

There are many test methods available to provide information about the condition of the lubricant in service of a gear box. The basic oil analysis should include the following tests:

Type of Oil	Test of new and used oil				
Industrial Gear Oil	Kinematic Viscosity at 40 degree C.in cSt	Water content in PPM or %age	Acid number mg KOH/g	Particle count and size distribution.as per ISO 4406.No of particle per ml	Oil Additive, Contamination and wear elements in ppm

In all cases, comparison of the results should be made to a sample of the new oil that was actually used in the equipment to be sure that the starting material was within the specified limits stated by the supplier. The baseline values of the new oil also should be based on analysis of the actual sample. Based on the results of the analysis, lubricant can be changed or upgraded to meet the specific operating requirements.

Viscosity

Viscosity is a key property of the gear oil. The oil might lose its ability to lubricate properly if its viscosity changes significantly. Oxidation of oil leads to an increase in viscosity. There are many other possible causes for an increase or decrease in viscosity. Kinematic viscosity can be checked by ISO 3104 / ASTM D445 test method. It is recommended to change the gear oil if its viscosity changes more than ± 10%.

Water Content

Water is a significant factor in lubricant degradation. When combined with iron or copper particles, water becomes even more powerful in attacking lubricant base stocks and additives. The adverse effects of water in oil include: Lubricant breakdown, through oxidation and additive precipitation, changes in viscosity affecting the ability of a lubricant to maintain the film thickness necessary to protect the lubricated surfaces and corrosion.

Water content can be checked by ASTM D6304 test method. It is recommended to change the gear oil when its water content is greater than 0.05% (500 ppm).

Acid Number

The acid number (AN) also referred as total acid number (TAN) test is one of the methods to estimate the amount of additive depletion, acidic contamination and oxidation. It may be noted that AN test does not directly measure the rate of oxidation, it merely measures the by-product of oxidation. It is also beneficial to trend AN to determine the rate of depletion of certain additives.

AN is the measure of acid concentration in petroleum products and lubricants. It is determined by the amount of potassium hydroxide (KOH) required to neutralize the acid in one gram of the sample. The standard unit of measure is mg KOH/g. The AN measurement detects both weak organic acids and strong inorganic acids. However, AN does not represent the absolute acid concentration of the oil sample. AN tests can be carried out by two titration methods: potentiometric and color-indicator. The potentiometric method (ASTM D664 / ISO 6619) uses a potentiometer to detect the acidic constituents and coverts it to an electronic read out. The output is plotted and analyzed to determine the inflection of the test method. The color-indicator method (ASTM D974 /

ISO 6618) uses p-naphtholbenzein solution (orange in acid and green-brown in base). Once the acidic constituents have been neutralized by the KOH, the sample change from orange to green, indicating the end point. Acid numbers should not be allowed to increase more than +0.5 AN higher than that of new oil, and if +1 AN is spotted immediate action is required (i.e. if new oil has 0.5 AN, then 1.0 AN is alert and 1.5 AN is alarm value). Acid can be neutralized or removed from oil in different ways. The obvious is to use the alkalinity of the oil to neutralize incoming acid. This is done in gas and diesel engine lube oils. These oils utilize high base numbers (BN or TBN), i.e. new oil is having high BN.

Particle Count and Size Distribution

A good filtering system for the lubricant is very important. The design filtration level may vary, but filtration to a 12 micron or finer nominal particle size is a generally accepted value. Filtration finer than 12 microns is recommended when light turbine lubricants are used, particularly for higher operating temperatures.

Since particle contamination of oil is one of the main reasons for a machine to break down, monitoring the level of hard contaminants is vital. ISO 4406 establishes the relationship between particle counts and cleanliness in hydraulic fluids (common practice has extended the application of this standard to lubricants as well). The ISO 4406 method for coding the level of contamination of solid particles is a classification system that converts a given particle count into an ISO code.

The test methods used most frequently for counting particles are: automatic particle count according to ISO 11500 and manual particle count according to ISO 4407.

In automatic particle count method according to ISO 11500, the contamination level of a liquid sample is determined by automatic particle counting, using the light extinction principle. In this method, the particle concentration is reported at three sizes: ≥4, ≥6 and ≥14 µm

In manual particle counting method according to ISO 4407, particles deposited on the surface of a membrane filter are counted using an optical microscope. It includes particle counting by two manual methods and image analysis, using either transmitted or incident lighting systems. In this method, the particle concentration is required to be reported at three sizes: ≥2, ≥5 and ≥15 µm.

Elemental Analysis for Additives and Wear Metals

Some additives, such as antiwear and extreme pressure additives and rust, oxidation, and corrosion inhibitors, are consumed as they are used. When all of a particular additive has been consumed, the lubricant will be no longer be capable of performing as originally intended. Monitoring the concentrations of wear metals in a lubricant can indicate abnormal wear of the machine components if base line concentration data are available for comparison. Elemental analysis determines concentration of wear metals, contaminants and oil additives in a sample for condition monitoring. ASTM D5185 method is used for the ICP instrument. Generally, ASTM D5185 method is used for elemental analysis.

A total of 22 elements (Al, Ba, B, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, K, Na, Si, Ag, S, Sn, Ti, V, Zn) can be determined by the ASTM D5185 test method - "Standard Test Method for Multi-element Determination of Used and Unused Lubricating Oils and Base Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)".

Typical wear metal elements, contaminants and additive elements are as under:

- Wear metals are: Aluminium (Al), Boron (B), Copper (Cu), Chromium (Cr), Iron (Fe), Lead (Pb), Silicone (Si) and Tin (Sn)
- Contaminants are: Silicone (Si) from dirt, Sodium (Na), Potassium (K) and Boron (B) from coolant
- Additive elements are: Boron (B), Barium (Ba), Calcium (Ca), Magnesium (Mg), Manganese (Mn), Phosphorus (P), Sulphur (S), Silicone (Si) and Zinc (Zn)

It may be noted that some elements are used as both additives and wear metals. Monitoring their content is then crucial because a decreasing or an increasing value will induce different actions. When additives are consumed as they are used, usually lubricant requires replacement. However, in some cases replenishment of the additives is possible. The lubricant manufacturer should be consulted before this is attempted.

Note: It is recommended to consistently use the same lab and test method for a specific lubricant analysis to eliminate reproducibility error. As per ASTM, reproducibility is "the difference between two single independent results obtained by different operators working in different laboratories on identical test material."

Abnormally High Temperature Oil level too high- If the oil level in a gearbox is so high that the gear runs in the oil, then the resulting churning action will heat the oil.

Hot weather- Obviously, a high ambient temperature will cause abnormally high oil temperature. To prevent this, provide adequate ventilation around the drive.

Low oil pressure (in case of a forced lubrication system) - If the oil flow to the bearings and gear mesh is below normal (indicated by below normal oil pressure),

the heat created by friction at the mesh and bearings will cause abnormally high temperatures. To correct this situation, check the lubrication system for proper operation. Low Oil Pressure Use of a lubricant which has a viscosity less than that for which the lube system was designed.

Many times several orifices are installed in the lube system. They are sized for lubricants with a particular viscosity. A lubricant with less than this normal viscosity will pass through the orifices without building up pressure. This situation can be prevented by using the lubricant designated on the name plate of the gear unit. Abnormally low viscosity may also result from high lubricant temperatures.

Clogged oil filter- Replacing the filter will allow more oil to flow through it, thus bringing the oil pressure back to normal. Pump cavitation - Should the oil level in the reservoir get so low that the pump suction line sucks both air and oil, then the oil pressure will drop. This problem may be cured by maintaining proper oil level in the reservoir.

Air leak in the suction line to the pump- This situation is similar to pump cavitation in that air gets in the oil and results in low oil pressure. To remedy this problem, check and tighten all pipe fittings in the suction line.

Incorrect relief valve setting- Adjusting the relief valve setting properly will avoid venting the pump discharge line back to the sump.

Unusual or Excessive Noise

Worn parts - One common cause of unusual noise is worn parts. If a part wears enough to cause slack in the system, the slack may be heard as a rattle or noise of some sort. A mechanic's stethoscope may be used to pinpoint the worn part which should be replaced.

Tips for Visual Inspection of Gear box

Visual inspection of gears for wear/damage and tooth contact pattern through an inspection port should be carried out periodically. Detecting a problem in its earliest stages can save time and money in the long run. If the gears or bearings are damaged but still functional, you may decide to continue operation and monitor damage progression. In this case, the gearbox should be continuously monitored. You should also make certain that there is no risk to human life. Many times gearboxes operate in dirty environments. Therefore, areas around inspection ports should be cleaned before they are opened for inspection. Inspectors should take care not to drop anything into the gearbox. Inspection ports should never be left open during breaks and should be closed after the inspection is complete.

About the Author

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"What are the corrective actions for a high particle count? **Is there any standard particle count for fresh oil?"**

There are multiple corrective actions for a high particle count. Selecting the appropriate action will depend on the operational and environmental conditions. If a high particle count is noticed in a component through oil analysis, the first question you should ask is where are the particles originating.

The initial reaction is usually to change or filter the oil. However, determining where the particles are coming from can save time, money and numerous headaches down the road. Simply removing the particles only focuses on the failure symptom and not the root cause.

Common root causes of high particle counts include new oil, ventilation and breathers, seals, wear generation, service and manufacturing debris, and filter dumping or bypassing.

New Oil

It is a common misconception that new oil is clean. In fact, when tested straight from an unopened drum, most new oils have particle counts that are in some cases 32 times dirtier than what you would prefer to have in your equipment.

Ventilation and Breathers

Every machine "breathes," so proper precautions must be taken to ensure that clean, dry air is entering the system. Otherwise, particles will build to uncontrollable amounts over time.

Wear Generation

Some particles measured during a particle count may not be strictly contamination from outside sources but rather the effect of this contamination in the form of wear debris.

Service and Manufacturing Debris

Even brand-new equipment must be inspected for cleanliness. Often new components are not flushed or cleaned after assembly. This will lead to high particle counts after installation.

Filter Dumping or Bypassing

Systems with built-in filtration may run dirty because of operational conditions or a flaw in the design. In this case, all the particles that you assume are being caught by the filtration system are being sent throughout the internal components.

While this is by no means a complete list of potential
causes of high particle counts, it does represent some of the most common. The best practice is to determine how the particles are entering or being generated by the system.

It has been proven that exclusion of particles is 10 times more cost-effective than removal. Therefore, exclusion should be the first priority, and then a focus can be placed on removal.

Keep in mind that new oil particle counts vary widely, and many factors contribute to high particle counts. The simple truth is that new oil should be assumed to be dirty, and it must be cleaned before being used.

"What is the best method to detect soot in diesel oil? Our labs use Fourier transform infrared (FTIR) spectroscopy as a primary means of measuring soot in used diesel engine oils.

I have been told that viscosity at 40 degrees C is a good indicator as well. Which instruments or methods will give me the most accurate soot level?"

There are several available tests that can detect soot load in diesel oil. As a screen test with a lower cost, FTIR is a great indicator of soot.

It is capable of measuring more than a dozen parameters, with some more reliable than others depending on the susceptibility to interference in the established wavenumber region.

While the data collection is relatively easy, there are challenges with measurement accuracy, especially as the size of the soot particles increases and constituents like dirt are included.

The maximum detection limit can range from 1.5 to 5 percent. This is concerning since the critical limits for engines with exhaust gas recirculation (EGR) may be 8 percent, and non-EGR systems may be around 5 percent.

Other alternatives include the pentane insolubles test, the light extinction method and thermogravimetric analysis. The pentane insolubles test consists of separating insolubles from the oil with the aid of a solvent mixed with the lubricant.

The solvent may commonly be pentane and toluene. The insolubles are flung out of the mixture with a centrifuge or filtered out with a filter membrane. While this is a preferred method with a lower cost, it poses concerns when other insolubles are included, as they will be measured together.

The light extinction method involves light being casted at specific frequencies through the oil and then measuring its obstruction by the drop in voltage. Again, there are some issues with this method related to other potential objects obstructing the light, even water and air bubbles.

Thermogravimetric analysis may be the most accurate measurements of soot load in an oil sample. It requires heating a sample through different stages to calculate the soot concentration by comparing the difference in weight of the volatile ash components to the original sample.

This test may have a much higher cost, so it is not a viable substitution for routine tests. Nevertheless, it is perfectly acceptable for exception testing after a screening test has been performed.

Soot dispersancy is an important lubricant property. It is defined as the lubricant's ability to keep soot particles finely dispersed and avoid agglomeration into larger soot particles.

This can be measured with a simple method known as the blotter spot test, which allows for a visual representation of the soot's dispersancy. ML

The "Lube-Tips" section of *Machinery Lubrication* magazine features innovative ideas submitted by our readers.

Inspect Your Oil Level Gauges

Routinely inspect the vent hole in column-type vented level gauges. In dirty environments, the vent hole can become easily plugged, causing an air lock in the gauge headspace. This will result in a false oil level (higher than reality) in the gauge. Many prefer dual-port gauges instead (unvented).

Lab Reports Require Quick Action

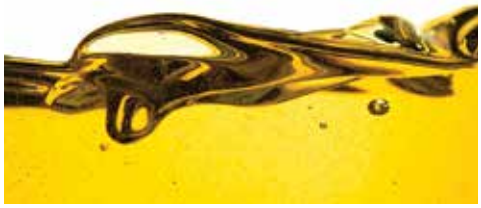
Unless you have special arrangements, most laboratories retain your oil sample for only a short period of time. Seven to 14 days is typical. When you get back your reports and have a questionable result or want to have additional testing performed, call the lab immediately to avoid the risk of your sample being discarded.

Getting More from Your Reservoir

A properly constructed reservoir is more than just a tank to hold the oil until the pump demands fluid. Whenever practical, it should also be capable of dissipating heat from the oil, separating air from the oil and settling out contamination in the oil. Never mix lubricants.

Reasons for Increased Viscosity

Assuming that no water is emulsified in the system, some reasons for an increase in viscosity of a circulating oil might include: the oil may have oxidized, pressure could have increased, temperature might have decreased, possible contamination with a higher viscosity fluid, evaporative losses of light oil fractions from high temperatures, glycol contamination and soot contamination. ***ML***



Did You Know?

Additional tips can be found in our Lube-Tips email newsletter. To receive the Lube-Tips newsletter, subscribe now at machinerylubricationindia.com

Have Some Tips?

If you have a tip to share, email it to admin@machinerylubri-cationindia.com

Travis Richardson | Noria Corporation

Understanding the Difference **Between Used Oil and Waste Oil**

> It often gets noticeably quiet when you ask most people about how the lubricants are handled once they are drained from a machine.

There is a lot of time and money invested in getting good, clean oil delivered to industrial sites around the world today. Upon initial reception at proactive, best-practice facilities, a lubricant may be tested for cleanliness, go through a filtration system and stored in a climate-controlled lube room prior to being staged for later use. When needed, these lubricants are introduced into a machine where they will lubricate components until they have reached the end of their life, but then what? While assessing lubrication programs in multiple

industries it is clear to see the amount of detail put into the front half of a lubricants life. However, it often gets noticeably quiet when you ask most people about how the lubricants are handled once they are drained from a machine. The general consensus is to put these oils in containers labeled used or waste oil and have them removed from the site. However, there are federal and state regulations as well as cost benefit factors that can be affected by the handling of these lubricants.

Before we review how these lubricants should be handled, let's first go over the difference between used oil and waste oil. The Environmental Protection Agency (EPA) defines used oil as any oil that has been refined from crude oil or any synthetic oil that has been used and, as a result of such use, is contaminated by physical or chemical impurities. To break down this definition a little more, let's go over the origin as well as machines it might come from and the contamination that makes it used oil.

In order to fall under the used oil specification, it must have started as crude oil (refined oil from the ground) or synthetic oil (man-made oil from petroleum materials). Drained lubricants that derived from vegetable or animal oil can not be classified as used oil. Typical machines that used oil might come from include vehicle engines, industrial gearboxes and pumps, compressors and even hydraulic units. The physical contamination that makes these lubricants fall into the used oil category might include metal shavings or debris from the machines they are used in, while the chemical impurities can come from the reaction of the lubricant with the above-mentioned contaminants.

Waste oil is any oil that has been mixed with a known hazardous substance. This oil might come from a machine where a lubricant and a chemical that is a known hazardous substance, such as cyanide, have a potential for mixing. A brand-new drum of oil could also be considered hazardous waste before ever being put into a machine if it is exposed to another hazardous substance. For this reason, it is extremely important to keep lubricants – both used and new – away from hazardous substances. The Resource and Recovery Act (RCRA), which is an EPA document that describes how to handle and control hazardous waste, classifies hazardous waste in the following ways:

- **Characteristic** – Waste exhibits hazardous characteristics such as corrosivity, reactivity, ignitability or toxicity.
- **Acutely hazardous** – Waste is fatal to humans at low doses, lethal in animal studies at particular doses or otherwise capable of causing or significantly contributing to an increase in serious illness.
- **Listed as hazardous** – Waste is capable of posing a substantial present or potential hazard to human health or the environment when improperly managed.

Waste oil also includes new oils that have halogen concentrations that exceed 1,000 parts per million (ppm). Halogens include the following elements fluorine, chlorine, bromine, iodine, astatine and tennessine. One of the main ways halogens are found in lubricants is through the use of additives. If lubricants that use additives contain the aforementioned elements and exceed 1,000 ppm, they would fall into the waste oil category. One exception to this would be metalworking fluids that contain chlorinated paraffins, which might be excluded from the 1,000-ppm rule if they are going to be reclaimed.

Now that we have a clear understanding between used oil and waste oil, let's discuss how to handle these lubricants and what happens after they leave your garage or industrial site. One of the first things you will want to do is find out your local area and state regulations on how to handle these lubricants.

In Tulsa, Oklahoma (Noria's headquarters), residents can take up to five gallons to most major auto parts stores, as well as the city recycling center, free of charge. When handling used oils in an industrial setting, lubricants are generally brought to a storage container or containers that should be labeled used oil. It is very important to label these containers properly as it could cost up to 10 times more to dispose of waste oil as opposed to used oil as there are different regulations for the way they are handled. Tank materials, spill containment specifications and any necessary records of the contents of the tank should be noted in local and state regulations. A few general rules to follow are to have a containment that meets or exceeds 10 percent of the total stored volume, and to have an alarm set that will alert users the container is more than 90 percent full.

Another key point is to keep any hatches or openings in these containers shut at all times to avoid catching rainwater; generally companies charge per gallon to dispose of used oil and if the tank has any water in it, you are getting charged for it. If it is waste oil, it should be properly labeled as well and kept away from used oil to avoid contamination and making it waste oil. Some used oil haulers will bring separate containers out for specific oils, which makes it easy for them to reclaim and use again.

So what happens with these lubricants after they are removed from your site? Certain used oils go through a reclamation process where they are filtered of any

contaminants they may have and used again in the machines they were removed from. Although this process doesn't take lubricants back to their original condition it does, however, clean them up enough to be used either one or multiple more times. This is a huge cost benefit for the site as they don't have to pay disposal fees or the price of new oil every time they change the lubricant. While most sites pay to have used oils removed from their storage, there are certain companies now that don't charge you to haul off your used oil; they will actually pay you for it. When companies do this, they are generally doing one of two things; either refining it to be used as a base oil or using it as heating oil. When utilized as a base stock, these used lubricants are run through a stringent refining process to be cleared of any impurities and oxidation compounds they may have, while heating oils are stripped of any moisture they might have before being used.

There is much confusion among industry today about whether to label consumed as oil used oil or waste oil. Used oil is any oil that has been refined from crude or synthetic oil and has been contaminated as a result of its use. Waste oil is any oil that has been contaminated with known hazards by use or from its original ingredients. There are multiple options for how lubricants are managed when they are drained from a machine. They can be decontaminated and used in the same machine, reclaimed and used for base stocks or stripped of moisture and used for heating. Federal, state and local regulations have set standards on how to handle the lubricants and, if not followed, legal and financial ramifications may be incurred. ***ML***

About the Author

Travis Richardson is an associate technical consultant for Noria Corporation. He holds a Level II Machine Lubrication Technician (MLT) certification and a Level II Machine Lubricant Analyst (MLA) certification through the International Council for Machinery Lubrication (ICML). Contact Travis at trichardson@noria.com.

FROM THE READERS

Comments and feedback from some of our valued readers from different industries.

"My hearty congratulations to the Machinery Lubrication India (MLI) magazine team for reaching this milestone of 50th issue. I am sure MLI magazine being the first in India in the field of lubrication & oil analysis and has changed the way we look at machinery lubrication. Thanks for the best articles covered in every issue that made a big difference in understanding world-class lubrication practices."

K.N.V.Subrahmanyam
Technical Head - Oil Condition Monitoring
Singlepeak Lube Technologies

"It is a proud moment for all of us in the field of Lubrication Reliability that Machinery Lubrication India (MLI) has reached a great milestone of 50th issue. MLI magazine is one of the finest and most comprehensive collections of knowledge, field experience and industrial expert opinion. I wish Team MLI all the best for thousands of such 50th issues in future. Be the light and keep inspiring the Lubrication Engineers around the globe."

Anshuman Agrawal
Founder & Managing Director
Minimac Systems Pvt Ltd

"I have been reading MLI magazine since the first issue. I really appreciate the authors, editors and publication team for articulating complex topics in a way that even a person having a limited background in this field can easily understand the subject. It provides me great insight of not just technical stuff but also updates about what's happening in different domain of lubrication and reliability. Many congratulations to the entire team for achieving the 50th issue milestone!"

Mohammad Aatif
Lubricant Specialist
A.P. Moller – Maersk

"A highly recommended magazine for anyone related to lubricants, grease & coolants, may it be manufacturer, buyer or end user. The content is well explained and very informative. My sincere thanks to MLI team for spreading awareness & knowledge."

Manik Das
AGM - Technical Services
Valvoline Cummins Private Limited

"Machinery Lubrication covers all aspects of lubrication ranging from case studies, learning from failures, best practices, new developments and new technologies. It is a must-read for all Maintenance Engineers. Congratulations to the Team for Machinery Lubrication India's 50th issue and best wishes for many more hundreds."

G.R.P. Singh
Head - QAG, One Shared Services Technology Group
Tata Steel Limited

"As a regular reader of Machinery Lubrication India, I find the insights and articles on current developments inspiring and it keeps me updated in various aspects of machinery lubrication and management. Many times I get newer insights as I read the key articles again. As an international trainer, I find the resources very valuable. The editorial team is doing an amazing job by bringing together the current trends across the globe with articles from technology leaders and academicians."

Balasubramaniam Ganapathy
Trainer & Course Instructor (Oil & Gas)

BASE OIL REPORT

India's October crude oil imports posted their steepest fall since July and seventh consecutive monthly year-on-year decline as rising COVID-19 cases limited mobility and curbed consumption. When we come across such a huge fall (in imports), it generally points towards the fact that the existing demand is already being met by inventory from prior months." The import of oil products also slumped 53% to 1.65 million tonnes in October. Meanwhile, exports of refined products fell 35.7% in October from a year ago to 3.84 million tonnes, and were down 20% from 4.80 million tonnes in September.

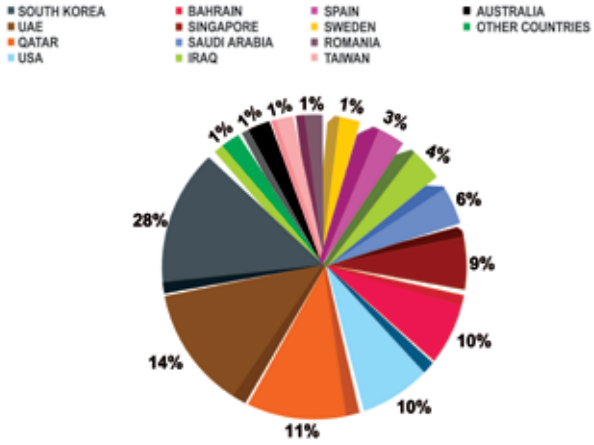
The Indian domestic market Korean origin Group II plus N-60–70/150/500 price at the current level is marginally up for lighter grades and heavier grades. As per conversation with domestic importers and traders prices for N – 70/ N- 150/ N - 500 grades and at the current level are quoted in the range of Rs. 46.85 – 47.00/46.85–47.00/50.95 – 51.10 per liter in bulk plus 18% GST as applicable. The above mentioned prices are offered by a manufacturer who also offers the grades in the domestic market, while another importer trader is offering the grades cheaper by Rs.0.30 – 0.35 per liter on basic prices. Light Liquid Paraffin (IP) is priced at Rs.47.30 – 47.45 per liter in bulk and Heavy Liquid paraffin (IP) is Rs.54.35 – 54.50 per liter in bulk respectively plus GST as applicable.

While in the month of September 2020, India imported 378614 MT of Base Oil, India imported the huge quantum in small shipments on different ports like 164708 MT (44%) into Mumbai, 56257 MT (15%) into Pipavav, 46310 MT (12%) into Hazira, 38578 MT (10%) into JNPT, 27573 MT (7%) into Chennai, 22471 MT (6%) into Mundra, 8305 MT (2%) into Kandla, 7948 MT (2%) into Kolkata, 3135 MT (1%) into Ennore and 3329 MT (1%) into Other Ports.

Dhiren Shah
(Editor – In – Chief of Petrosil Group)
E-mail- dhiren@petrosil.com

Month wise import of Base Oil in India

Origin wise Base Oil import to India, Country and %- September 2020



Base Oil Group I & Group II CFR India prices:-

Month	N- 70 Korea Origin Base Oil CFR India Prices	Bright stock USA Origin CFR India Prices	N- 500 Singapore Origin Base Oil CFR India Prices	RPO Drums (Aromatic Extract) CFR India Prices
September 2020	USD 490 – 500 PMT	USD 590 – 620 PMT	USD 540 - 560 PMT	USD 250 – 260 PMT
October 2020	USD 460 – 480 PMT	USD 630 – 670 PMT	USD 560 - 580 PMT	USD 245 - 260 PMT
November 2020	USD 560 – 585 PMT	USD 660 - 705 PMT	USD 580 - 605 PMT	USD 250 – 260 PMT
	Since September 2020, prices have increased by USD 75 PMT (15%) in November 2020	Since September 2020, prices hiked up by USD 75 PMT (10%) in November 2020.	Since September 2020, prices have increased by USD 40 PMT (7%) in November 2020.	Since September 2020, prices have remained steady in November 2020.

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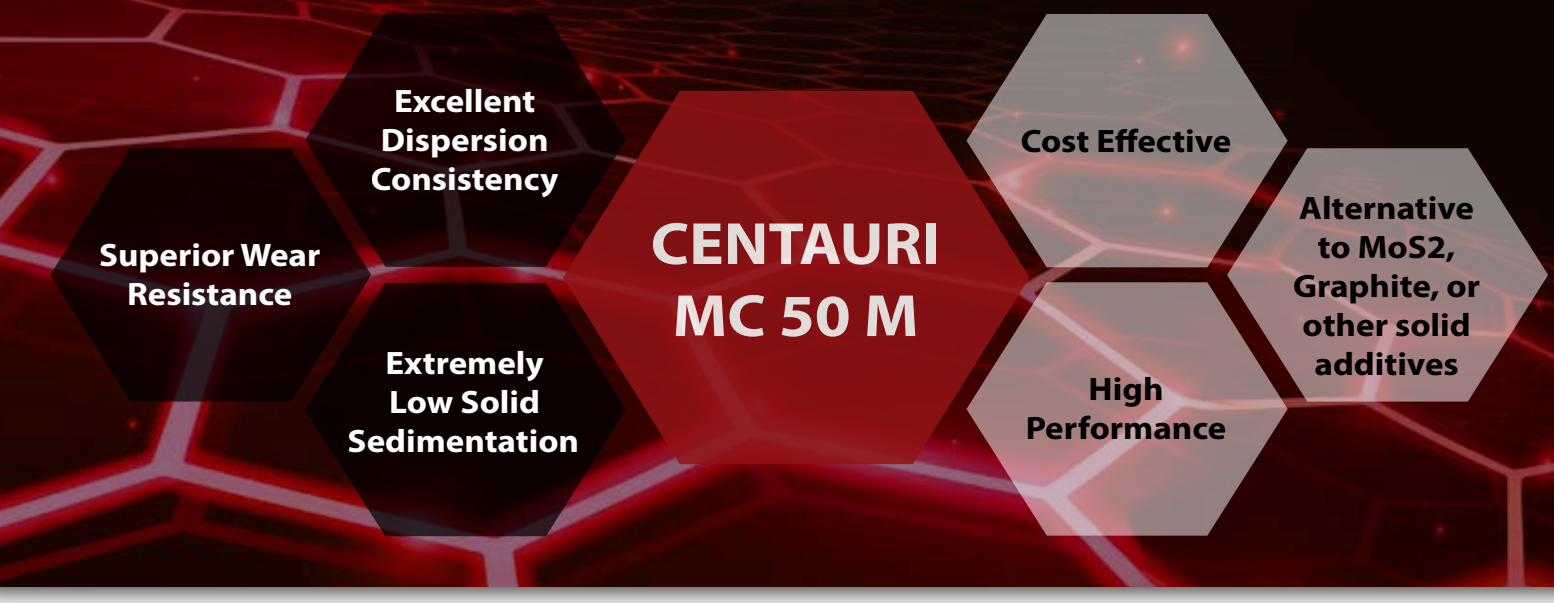

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- Enhanced extreme pressure (EP), Anti-Wear (AW) and Anti-Friction properties
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- Superior colloidal stability
- No particle accumulation
- Does not negatively impact drop point temperatures
- Ash, varnish, and deposits are completely prevented as the Micro Ceramic solids remain neutral at temperatures above 450 °C in comparison to MoS2 solids which create hazardous by-products at such temperatures.

Technical Data

Temp. Range:	-30 °C to 450 °C
Appearance	white liquid paste
Base-Oil:	Group 3 SN150
Base Oil / Solids:	50/50
Dynamic Viscosity:	4000 - 8000 mPa*s
Density (20 °C):	1,1 kg / dm^3

Application Area

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